Claims

[c1] 1.A system for remotely measuring signals in a circuit under test comprising:
means for establishing a first signal in a first selected current path in said circuit;
means for establishing a first focused magnetic field at a selected position in said first current path;
means for converting said first focused magnetic field into a first Hall voltage;
means for transmitting said first Hall voltage to a first frequency gated amplifier;
means for gating said amplifier with a first selected signal having a first selected frequency; to modulate, in the amplifier, the converted Hall voltage to provide, at the output of said first amplifier, a second current pulsating at the frequency of said first selected signal;
means for transmitting said pulsating flow of current pulses through a second current path to establish in said second current path a second focused magnetic field pulsing at the frequency of said first signal; and,
remote magnetic sensing means for detecting said pulsating magnetic field and for providing a electrical output directly proportional to the current in said first path.

[c2] 2. The system of claim 1 wherein said remote magnetic sensing means is a superconducting quantum interference device.

[c3] 3. The system of claim 2 the output of said superconducting quantum interference device is coupled to a lock-in amplifier synchronized to the respective frequency pulsing the sensed magnetic field transmitters.

[c4] 4. A method of remotely detecting and establishing the value of currents in circuits in an integrated semiconductor device comprising the steps of:
selecting an integrated semiconductor device;
applying a voltage to a first selected circuit in said device to establish a first quiescent current in a selected portion of said first selected circuit;
sensing said first quiescent current in said selected portion of said first selected circuit,
converting said sensed first quiescent current in said first selected circuit to a first Hall voltage with a first magnetic field concentrator and a first Hall sensor,
amplifying said first Hall voltage;
modulating said amplified first Hall voltage with a first known frequency,
converting said amplified and modulated first Hall voltage with a second magnetic field concentrator to create a

first magnetic field pulsing at said known first frequency; and

detecting said pulsating first magnetic field with a first remote sensor to provide an output signal proportional to said first sensed current.

[c5] 5.The method of claim 4 wherein there is further included the steps of:

applying a voltage to a second selected circuit in said device to establish a second quiescent current in a selected portion of said second selected circuit;

sensing said second quiescent current in said selected portion of said second selected circuit,

converting said sensed second quiescent current in said second selected circuit to a second Hall voltage with a third magnetic field concentrator and a second Hall sensor,

amplifying said second Hall voltage;

modulating said amplified second Hall voltage with a second known frequency,

converting said amplified and modulated second Hall voltage with a fourth magnetic field concentrator to create a second magnetic field pulsing at said known second frequency; and

detecting said pulsating second magnetic field with a second remote sensor to provide an output signal pro-

portional to said second sensed current.

[c6] 6.The method of claim 4 wherein there is further included the steps of:
applying a selected voltage to a second selected circuit in said chip to establish a current therein;
directing said current in said second circuit through a third magnetic field concentrator to establish a steady state magnetic field;
converting said second magnetic field into a third voltage
applying a second frequency to said third voltage to modulate said third voltage;
creating from said third modulated voltage a second pulsating magnetic field that is pulsating at said second frequency;
measuring said second pulsating magnetic field with a second remote sensor to convert said second pulsating magnetic field into an output signal proportional to said current in said second selected integrated circuit;
applying the output signal of the first remote sensor and the output signal of the second remote sensor to a lock-in amplifier and synchronizing the output signal of said first remote sensor with said first frequency and synchronizing the output signal of said second remote sensor with said second frequency to provide at the output

of the lock-in amplifier analog current information from each sensing location without crosstalk between the sensing circuits and without noise in the form of stray extraneous magnetic fields and other induced errors in the tested circuit.

[c7] 7.A semiconductor testing apparatus comprising:
means for holding a semiconductor device to be tested;
means for applying an electrical signal to the semiconductor device to be tested to induce in said device a current through a selected path in said device
means for establishing a current in a selected current path in said circuit;
means for establishing a focused magnetic field at a selected position in said current path;
means for converting said focused magnetic field into a Hall voltage;
means for transmitting said Hall voltage to a second gated amplifier;
means for gating said amplifier with a selected signal with a selected frequency; to modulate, in the amplifier, the converted Hall voltage to provide, at the output of said amplifier, a current pulsating at the frequency of said selected signal;
means for transmitting said pulsating current pulses through a current path to establish in said current path a

focused magnetic field pulsing at the frequency of said signal; and,

remote magnetic sensing means for detecting said pulsating magnetic field and for providing a electrical output proportional to the current in said path.